RAPID BIOASSESSMENT OF THE

BARR CREEK AND BIG CREEK WATERSHEDS

USING BENTHIC MACROINVERTEBRATES

for the Soil and Water Conservation Districts of
Vanderburgh and Posey Counties

Study Conducted in July and December 1994

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

A rapid bioassessment technique was used to determine the degree of biological impairment present in Barr Creek and Big Creek in southwestern Indiana prior to full implementation of various land treatments in the Barr Creek watershed. The benthic communities of four sites and a nearby reference stream were sampled during July and December 1994 to provide information on "before treatment" conditions.

The aquatic habitat value of both Barr Creek and Big Creek were quite low compared to that of the reference stream (Rush Creek in western Posey County, which is known to be among the highest-quality headwater streams in southwestern Indiana). Both Barr Creek and Big Creek were highly channelized, with steep bank slopes and stream bottoms composed mostly of sand and silt. Neither stream had much natural riparian vegetation, and shading was nearly absent.

The benthic communities of all study sites were "slightly" to "moderately" impacted compared to that of Rush Creek. Barr Creek appeared to be in better condition than Big Creek, and its benthic community is about as good as present habitat conditions allow. However, Barr Creek also exhibits signs of higher than normal nutrient enrichment, probably from agricultural sources. Big Creek has slightly degraded water quality as well as degraded habitat. There is some evidence that high water temperatures associated with lack of shading may contribute to the biological impairment observed in Big Creek and possibly in lower Barr Creek as well.

Recommendations to restore and enhance the biological condition of these streams include additional land treatments, protecting and planting streamside vegetation, and minimization of ditching projects.

INTRODUCTION

This study was conducted to measure the "biological integrity" of Big Creek and one of its tributaries (Barr Creek) in southwestern Indiana. Both streams have been identified by the Soil and Water Conservation Districts of Vanderburgh and Posey Counties and the Indiana Department of Environmental Management as having seriously degraded water quality due to nonpoint sources of pollution [1]. Soil conservation measures were planned by the Indiana Department of Natural Resources (IDNR) and the Districts to improve the water quality of these streams. By conducting studies of the biological community of Barr Creek and Big Creek before and after application of land treatments in the watersheds, IDNR wanted to determine whether treatments resulted in improved water quality as reflected by an improved aquatic biological community.

Land treatments in the watershed were initiated in October 1993 and continued through the summer of 1994. The first biological study was conducted in July 1994. A second study was planned for October 1994. However, an unusually dry summer caused both study streams to stop flowing for several weeks. Since the bioassessment technique requires flowing waters, the second study was postponed until December 1994, allowing the benthic community a chance to become established once again.

Local Setting

Barr Creek and Big Creek are located in the "Interior River Lowland" ecoregion of the Central U.S. [2]. This ecoregion is composed of a glacial till plain, often covered with a thick layer of loess soils. Land use patterns are extremely variable in this ecoregion because the soils and topography are more variable than in most other ecoregions. Natural vegetation is usually dominated by oak/hickory forests.

Barr Creek is a "third order" stream with a total watershed area of about 36 square kilometers. It originates in Vanderburgh County and flows northwestward, joining Big Creek in Posey County. The lower segments of the stream are channelized but some of the upper tributaries retain their natural channel characteristics and about 25% of the upper watershed is wooded.

Big Creek is a somewhat larger "fourth order" stream and at its juncture with Barr Creek has a watershed area of about 160 square kilometers. Most of its length has been artificially channelized to facilitate drainage of agricultural fields. Less than 10% of the watershed is wooded. There are numerous small oil wells in the watershed.

Four sites were chosen for study in these watersheds (Fig. 1). The sites on Barr Creek were chosen to represent the upper and lower watershed areas. The sites on Big Creek were chosen to represent the watershed upstream and downstream from Barr Creek. A summary of each site and its watershed area is shown below:

Site 2	Barr Creek @ County Line Rd.	23 km^2
Site 3	Barr Creek @ its confluence w/ Big Cr.	36 km^2
Site 4	Big Creek @ Water Tank Rd.	160 km^2
Site 5	Big Creek @ Emge Rd.	196 km^2

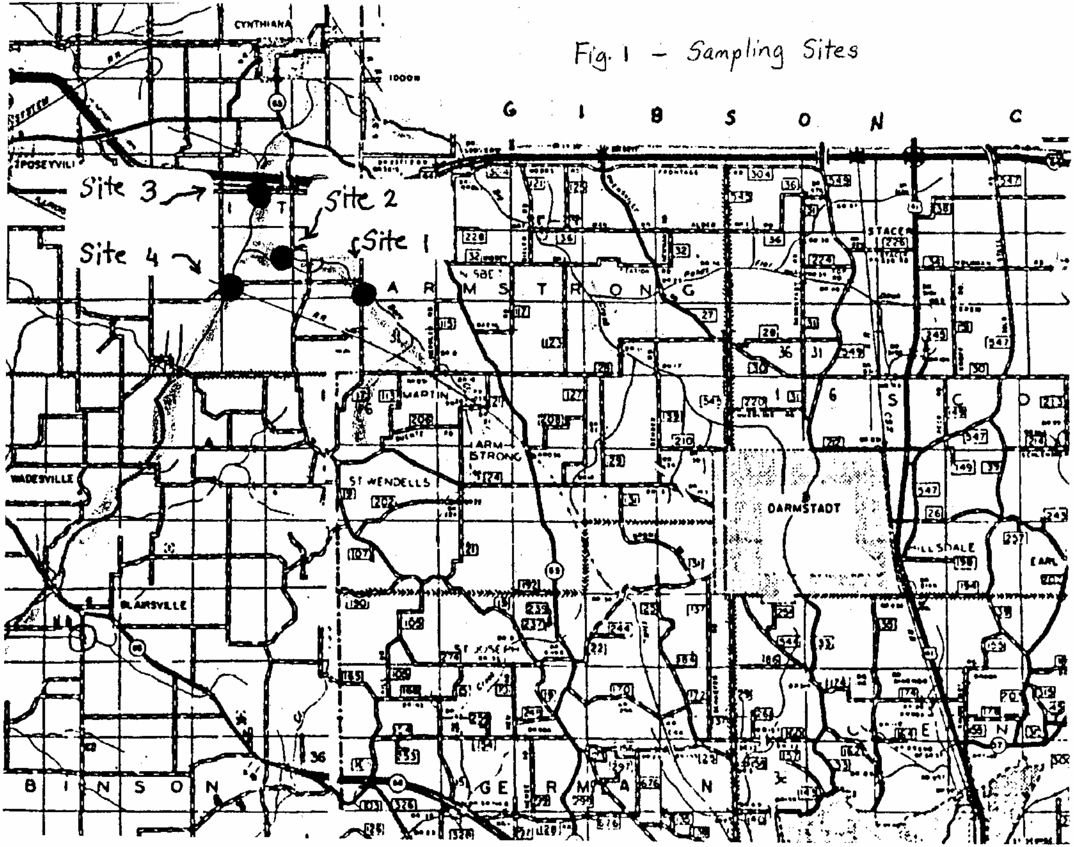

Fig. 1 - Sampling Sites

METHODS

Because they are considered to be more sensitive to local conditions and respond relatively rapidly to change [3], benthic (bottom-dwelling) organisms were used to document the biological condition of both Barr Creek and Big Creek. The U.S. Environmental Protection Agency (EPA) has recently developed a "rapid bioassessment" protocol [4] which has been shown to produce highly reproducible results that accurately reflect changes in water quality. We used EPA's Protocol III to conduct this study. Protocol III requires a standardized collection technique, a standardized subsampling technique, and identification of at least 100 animals from each site to the genus or species level from both "study sites" and a "reference site."

Reference Site

A reference site is required for comparison of its aquatic community to that of each study site. The reference site should be in the same "ecoregion" as the study sites and be approximately the same size. It should be as pristine as possible, representing the best conditions possible for that area. Because of extensive drainage projects in southwestern Indiana, most streams in the area have been drastically altered [5]. However, Rush Creek (a third order tributary of the Wabash River in western Posey County) appears to be relatively unimpacted. Much of the Rush Creek watershed is wooded and the stream remains mostly unchannelized. Its watershed area is about 45 square kilometers, which is similar to that of Barr Creek and Big Creek. Agriculture is an important land use in the watershed, but sedimentation does not appear to be as extensive as in Barr Creek or Big Creek. A fisheries study done in 1985 showed that, in contrast to other small streams in the area, Rush Creek still supports a fairly diverse fish community [6]. Also, the study showed that Rush Creek is one of the few places in southwestern Indiana which still supports a healthy population of "darters" (fish which are generally sensitive to environmental degradation [7]). The reference site was located on the County Road immediately upstream from Harmonie State Park.

Sample Collection

Samples in this study were collected by kicknet from riffle habitat where current speed was 20-30 cm/sec. Riffles were used because they were the most important benthic habitat present at all study sites. The kicknet was placed immediately downstream from a riffle while the sampler used a hand to dislodge all benthic organisms attached to rocks within the riffle. The organisms were swept by the current into the kicknet and subsequently transferred to a white pan. Each sample was examined in the field to assure that at least 100 organisms were collected at each site. In addition, each site was sampled for organisms in CPOM (coarse particulate organic matter, usually consisting of leaf packs from fast-current areas). All samples were preserved in the field with 70% isopropanol.

Laboratory Analysis

In the laboratory, a 100 organism subsample was prepared from each site by evenly distributing the whole sample in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample.

Each animal was identified to the lowest practical taxon (usually genus or species). As each new taxon was identified, a representative specimen was preserved as a "voucher." All voucher specimens will ultimately be deposited in the Purdue University Department of Entomology collection.

Data Analysis

Following identification of the animals in the sample, eight "metrics" were calculated for each site. These metrics are based on knowledge about the sensitivity of each species to changes in environmental conditions and how the benthic communities of unimpacted streams are usually organized. For example, EPT animals consist of those in the insect orders Ephemeroptera, Plecoptera, and Trichoptera, which are known to be more sensitive than most other benthic animals to degradation of environmental conditions. Feeding behaviors such as "scrapers", "filterers", and "shredders" change predictably under different conditions. The sum of all eight metrics provides an individual "biotic score" for each site.

Quality Assurance

To help assure the quality of the results, a duplicate sample was collected at Site 1 during December. The biological scores of each sample were measured to determine the amount of variability associated with the technique. Ideally, the individual scores of duplicate samples should be within about 10% of the mean score to assure that reproducible results are obtained.

RESULTS

Quality Assurance

The biotic index scores of site 1, as determined by duplicate benthic samples, were 40 and 42, respectively, during the December sampling period (see Appendix). These values were within 10% of the mean and the use impairment categories obtained by both samples were identical. This indicates that the bioassessment technique produced reliable results during the study period.

Aquatic Habitat Analysis

When the EPA habitat scoring technique was used, the following aquatic habitat values were obtained for each site in the study:

	Score	% of Reference
Rush Creek (reference, Site 1)	107	100
Upper Barr Creek (Site 2)	61	57
Lower Barr Creek (Site 3)	61	57
Upstream Big Creek (Site 4)	59	55
Downstream Big Creek (Site 5)	59	55

The maximum value obtainable by this scoring technique is 135, with higher values indicating better habitat. Sites with lower habitat values normally have lower biotic index values as well.

The scores indicate that all of the study sites had similar habitat values, all of which were considerably lower than that present at the reference site. All study sites were characterized by extremely steep bank slopes with a paucity of suitable bottom substrate and lack of streamside cover. All study sites also suffered from various degrees of channel alteration, lack of shading, and sediment deposition.

Water Chemistry

The following water quality measurements were obtained at each study site:

Water Quality Measurements
July 1994

	D.O. mg/l	pH SU	Cond. uS	Temp. (F)
Reference Site 1 9:50 a.m. (7/6/94)	7.3	8.2	530	78
Site 2 5:15 p.m. (7/5/94)	15.6	8.9	390	88
Site 3 1:30 p.m. (7/6/94)	12.2	9.3	350	97
Site 4 2:15 p.m. (7/5/94)	10.2	8.4	360	91
Site 5 3:30 p.m. (7/5/94)	18.6	9.2	310	95

Water Quality Measurements
December 1994

	D.O. mg/l	pH SU	Cond. uS	Temp. (F)
Reference Site 1 1:50 p.m. (12/28/94)	12.0	8.0	640	38
Site 2 5:35 p.m. (12/28/94)	12.0	7.8	500	40
Site 3 4:15 p.m. (12/28/94)	13.0	7.9	510	38
Site 4 3:20 p.m. (12/28/94)	13.4	8.0	440	41
Site 5 5:00 p.m. (12/28/94)	13.4	8.0	460	42

D.O. = Dissolved oxygen
Cond. = Conductivity
Temp. = Temperature in Degrees Fahrenheit

Benthic Communities

The types of benthic organisms collected from each study site are shown in Tables 1 and 3. The metric scores and site scores calculated from these data are shown in Tables 2 and 4.

Table 1
Rapid Bioassessment Results - Barr Creek and Big Creek - July 1994

	Site # 1	2	3	4	5
Chironomidae					
Glyptotendipes	1		1	32	41
Polypedilum convictum	12	1		3	2
P. fallax	2	1			
Pseudochironomus	1	1	3		2
Stictochironomus			1		
Thienemannymia	11	4	3	6	12
Simuliidae	7				
Trichoptera					
Cheumatopsyche	21	54	6	15	2
Hydropsyche simulans				4	
Emphemeroptera					
Caenis	1	6	7	3	1
Stenacron interpunctatum	24	2		3	1
Coleoptera					
Enochrus				1	
Berosus	1	6	13	12	4
Stenelmis	1	2	3	17	32
Dubiraphia			1		
Odonata					
Ischnura		2			
Argia	1	1	1	1	1
Amphipoda					
Hyalella azteca	1				
Isopoda					
Caecidotea	13				
Cambaridae	1	1			
Gastropoda					
Physella	1	16	59		2
Planorbella trivolvis		1	2		
Pelecypoda					
Eupara cubensis	1	2		3	
Total	100	100	100	100	100

Table 2. Data Analysis - July 1994

METRICS

	Site # 1	2	3	4	5
# of Genera	16	14	12	12	11
Biotic Index	6.9	7.3	8.4	7.4	7.3
Scrapers/Filterers	0.9	0.3	10	0.13	1.5
EPT/Chironomids	1.7	8.9	1.6	0.6	0.07
% Dominant Taxon	24	54	59	32	41
EPT Index	3	3	2	4	3
Community Loss Index	0.0	0.3	0.7	0.5	0.4
% Shredders (CPOM)	14	0	0	0	0

SCORING

	Site # 1	2	3	4	5
# of Genera	6	6	4	4	4
Biotic Index	6	6	4	6	6
Scrapers/Filterers	6	4	6	0	0
EPT/Chironomids	6	6	6	2	0
% Dominant Taxon	4	0	0	2	0
EPT Index	6	6	4	6	6
Community Loss Index	6	6	4	4	6
% Shredders (CPOM)	6	0	0	0	0
TOTAL	46	34	28	24	22
% of Reference	100	74	61	52	48
Impairment Category	N	S	S	M	M

N = NONE S = SLIGHT M = MODERATE

Table 3
Rapid Bioassessment Results - Barr Creek and Big Creek - Dec. 1994

	Site # 1	2	3	4	5
Chironomidae					
Dicrotendipes neomodestus					1
Pseudochironomus sp.					1
Orthocladius obumbratus	18	1	1	1	18
Heterotrissocladius sp.	1	2	2		3
Parametriocnemus sp.		1	5	2	3
Cardiocladius sp.	1				
Cricotopus bicinctus			1		
Thienemannymia group	7		1	1	
Simuliidae	2		1	7	
Tipulidae	1				
Trichoptera					
Cheumatopsyche sp.	49			23	
Chimarra obscura	1				
Neureclipsis sp.	1				
Emphemeroptera					
Caenis sp.	1				8
Stenacron interpunctatum	6			1	
Stenonema tripunctatum	1				
Plecoptera					
Allocapnia spp.		73	57		6
Coleoptera					
Berosus sp.				4	6
Stenelmis sp.			2	20	18
Dubiraphia sp.					1
Odonata					
Epitheca sp.					1
Argia sp.				5	3
Amphipoda					
Hyalella azteca	1	1			
Isopoda					
Caecidotea sp.	6	14	16		
Lirceus sp.		5	4		
Turbellaria	3		1	7	8
Gastropoda					
Physella			5	1	3
Planorbella trivolvis			1		
Fossaria sp.		1		1	
Pelecypoda					
Sphaerium sp.		2	2	20	6
Eupara cubensis	1			3	
Annelida					
Brachiura sowerbyi				1	6
other Tubificidae			1	3	8
Total	100	100	100	100	100

Table 4. Data Analysis - December 1994

METRICS

	Site # 1	2	3	4	5
# of Genera	16	9	15	16	17
Biotic Index	7.3	4.3	4.9	6.9	7.4
Scrapers/Filterers	0.13	0.5	2.0	0.06	0.5
EPT/Chironomids	2.2	18	5.7	6.0	0.54
% Dominant Taxon	49	73	57	23	18
EPT Index	6	1	1	2	2
Community Loss Index	0.0	1.1	0.5	0.4	0.5
% Shredders (CPOM)	69	84	58	0	6

SCORING

	Site # 1	2	3	4	5
# of Genera	6	4	6	6	6
Biotic Index	6	6	6	6	6
Scrapers/Filterers	6	6	6	4	6
EPT/Chironomids	6	6	6	6	2
% Dominant Taxon	0	0	0	4	6
EPT Index	6	0	0	0	0
Community Loss Index	6	4	4	6	4
% Shredders (CPOM)	6	6	6	0	0
TOTAL	42	32	34	32	30
% of Reference	100	76	81	76	71
Impairment Category	N	S	S	S	S

N = NONE S = SLIGHT M = MODERATE

DISCUSSION

Chemical measurements taken during the study show that dissolved oxygen (D.O.) fell within the range acceptable to most aquatic organisms. Several pH values during July were above 9.0, which is considered the upper limit of acceptability by some animals. Such high pH values were also accompanied by D.O. values well above saturation. These types of conditions are typically caused by rapid algal growth in the waterbody. It is common to find much lower D.O. values at these sites after several hours of darkness, when algal photosynthesis stops and respiration begins.

A total of 22 macroinvertebrate genera were collected at the five sites during July, while 33 genera were present during December. The most commonly collected organisms at most study sites during July were the midge Glyptotendipes, the caddisfly Cheumatopsyche, the snail Physella, or the riffle beetle Stenelmis. Some of these animals were also common during December (e.g. Cheumatopsyche), but other types of animals (e.g. the stonefly Allocapnia and the midge Orthocladius) became dominant at one or more sites during this early winter sampling period.

Figure 2 shows the normal relationship of biotic index scores to habitat values (a linear relationship according to [4]). The figure also shows a range of plus or minus 10% to account for a certain amount of measurement variability. When biotic index values fall below this range, the site typically has degraded water quality. Only the two sites on Big Creek during the July sampling period fell below the expected range. Extremely high water temperatures during July (up to 97° F) probably contributed to his problem.

Figure 2 also indicates that none of the study sites had biotic values lower than expected from their measured habitat values during December. In fact, most sites had biotic index scores which were somewhat higher than predicted by their available habitat. This situation is often found at sites affected by nutrient enrichment. Under such conditions, high nutrient inputs sustain the benthic fauna at a higher-than-expected level. However, as habitat or water quality degradation proceeds, nutrients are no longer able to sustain the community at the same level, and a drastic decrease in biological condition results [4]. Therefore, without some type of watershed management to keep conditions from deteriorating further, both Barr Creek and Big Creek may be poised on the brink of a steep decline in biological condition.

There is a strong indication that most sites, including the reference stream, were at least periodically exposed to high turbidity and/or sedimentation. Tables 5 and 6 show the relationship of the animals present at each site to their tolerance to high turbidity and sedimentation. The tables show that a large proportion of benthic animals in these streams were "tolerant" to sedimentation. Few "intolerant" animals were present. An exception to this observation was the large number of stoneflies (Allocapnia sp.) present in Barr Creek samples during December. This species, which is thought to be intolerant to sediment deposition, is known as a "winter stonefly" because it lies dormant in the egg stage deep within the stream bottom during the warmer months and emerges as an adult during late winter. The presence of numerous winter stonefly nymphs is a good indication that, despite a high degree of agricultural activity in the watershed, sediment deposition is probably not exceptionally high in Barr Creek.

Finally, there is also strong evidence that the reference stream itself (Rush Creek, as it flows into Harmonie State Park) may be somewhat degraded by less than desirable water quality from "organic" inputs (e.g. animal wastes or septic tank effluents). The Hilsenhoff Biotic Index ("Biotic Index" in Tables 2 and 4) is very sensitive to this type of stress. During both July and December, the Hilsenhoff Index value was between 6.9 and 7.3, which is considerably higher than found in most unpolluted Indiana streams and, according to [15], is indicative of "fairly poor water quality from significant organic pollution."

Figure 2

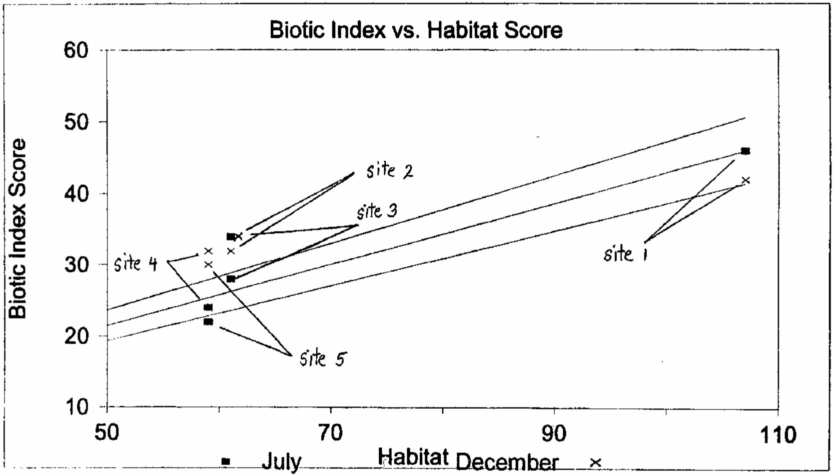
Biotic Index vs. Habitat Score
Biotic Index Score
60
50
40
30
20
10
50
70
90
110
Habitat
July
December
site 1
site 2
site 3
site 4
site 5

Table 5. Sediment-Tolerant Species Observed
(References shown in brackets)

Cheumatopsyche sp.	[8] [9]
Caenis sp.	[9] [11]
Stenacron interpunctatum	[9]
Polypedilum convictum	[9]
Thienemannymia group	[9]
Argia spp.	[9]
Ischnura spp.	[9]
Macronychus glabratus	[9]
Berosus sp.	[12]
Tubificidae	[11]

SEDIMENT-TOLERANT ORGANISMS

July Samples

% of All Organisms at the Reference Site 71%

% of All Organisms at the Study Sites

Site 2	74%
Site 3	32%
Site 4	43%
Site 5	23%

December Samples

% of All Organisms at the Reference Site 63%

% of All Organisms at the Study Sites

Site 2	38%
Site 3	40%
Site 4	53%
Site 5	39%

Table 6. Sediment-Intolerant Species Observed
(References shown in brackets)

Plecoptera	[9]
Stenonema tripunctatum	[9]
Chimarra sp.	[9]
Hyalella azteca	[10]

SEDIMENT-INTOLERANT ORGANISMS

July Samples

% of All Organisms at the Reference Site		1%
% of All Organisms at the Study Sites		
Site 2	0%	
Site 3	0%	
Site 4	0%	
Site 5	0%	

December Samples

% of All Organisms at the Reference Site		3%
% of All Organisms at the Study Sites		
Site 2	74%	
Site 3	57%	
Site 4	0%	
Site 5	6%	

Mussel Observations

Although not part of the original study plan, observations of mussels present in a stream are often useful. Mussels are very sensitive to changes in stream conditions and can be used to judge stream quality [16]. The following mussel species were observed at Site 3 on Big Creek:

Live Specimens
- Lasmigona complanata (White heelsplitter)
- Anodonta grandis (Giant floater)

Valves Only (2 valves, still attached)
- Elliptio dlatata (Spike)
- Leptodea fragilis (Fragile paper shell)
- Toxolasma texasensis (Texas lilliput)

Most of these species are widespread and fairly common in the Midwest. The Texas lilliput is a southern species, and extreme southwestern Indiana is at the northern part of its range.

Comparison to Other Studies

A fisheries study done in 1985 [6] showed that the fish community of Barr Creek was not very diverse (a total of 9 species at two sites) and was dominated by tolerant "minnow" species. In addition, the fish community of Big Creek [5] found that in the summer of 1980 Big Creek and its tributaries had relatively depressed fish communities, associated with low habitat value and high turbidity and sedimentation. The scientists conducting this study reported that Big Creek was dominated by a few "tolerant" species (those able to survive in conditions of poor water quality and degraded habitat) and that "intolerant" fish were virtually absent from most locations in the watershed. Only 10 fish species were present at two collecting sites on the upper portion of Big Creek. Healthy stream sites typically support 15-20 species. These two fisheries reports support the present study, showing that neither Barr Creek nor Big Creek are very good aquatic resources in their present states.

In contrast to these recent studies, older studies show that environmental conditions in Big Creek were once much better. For example, Gerking [13] collected 28 fish species, including the tadpole and brindled madtoms, at his two collecting sites on Big Creek in 1942. These relatively intolerant species have disappeared from the stream in the past 50 years. An even older study by Jordan [14] reported the presence of additional intolerant fish in his Big Creek collections of 1888. These included the bluntnose, johnny, slenderhead, and blackside darters, as well as the pugnose minnow. None of these species has been collected from Big Creek during the past 100 years. Habitat alterations and degraded water quality have probably eliminated these fish.

RECOMMENDATIONS

1. Continue to monitor these five sites during 1995 to determine whether land treatments in the Barr Creek watershed contribute to improved water quality.

2. In addition to encouraging erosion control practices, consider implementing programs which protect or restore natural streamside vegetation.

3. Identify all areas in both watersheds with severely slumping banks and implement stabilization projects (methods using natural vegetation should be preferred to riprap, since lack of shading is a problem in these watersheds).

4. Severe channelization of local streams has contributed to some of the observed water quality problems. Encourage local drainage boards to minuimize the frequency and magnitude of "ditching" projects in this area.

5. Although it is presently one of the highest-quality headwater streams in this area, Rush Creek appears to be in need of better watershed management practices as well. There seem to be unusually high sediment and "organic" inputs to this stream, possibly from livestock operations or failing septic tanks. Determine whether local landowners would be willing to participate in cost-share programs aimed at reducing these inputs.

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Rush Creek Duplicates
Metric Values

	Sample 1	Sample 2
Total Genera	16	16
EPT Genera	5	6
Scrapers/Filterers	0.15	0.13
% Dominant Taxon	41	49
EPT/Chironomids	1.6	2.2
Community Loss Index	0.0	0.0
Hilsenhoff Biotic Index	7.3	7.3
% Shredders in CPOM	37	69

Site Scores in Relation to the Reference

	Sample 1 Sample 2 as Reference	Sample 2 Sample 1 as Reference
Total Genera	6	6
EPT Genera	4	6
Scrapers/Filterers	6	6
% Dominant Taxon	0	0
EPT/Chironomids	6	6
Community Loss Index	6	6
Hilsenhoff Biotic Index	6	6
% Shredders in CPOM	6	6
	40	42

Mean Site Score = 41
Each duplicate is within 10% of the mean
Each score indicates "nonimpaired" conditions

MACROINVERTEBRATE DATA SHEET

Type of Sampler: Kicknet
Collection Depth:
Substrate Type: Riffle
Remarks: sorted by M. Broaddus
Identification by: M. Broaddus / G. Bright

Sample No.: # 1
Date: 12/28/94
Location: Rush Creek (Posey Co.)
Station #: Site 1
Collector: G. Bright

Enter Family and/or Genus and Species Name on Blank Line.

Organisms	No.	A.	I.
Diptera			
Chironomidae			
Orthocladius sp.	27		
Parametriocnemus	1		
Cardiocladius	1		
Heterotrissocladius	2		
Other Simuliidae	4		
Tipulidae	1		
Trichoptera			
Cheumatopsyche spp	41		
~~Cyrnellus frat~~			
Chimarra obscura	1		
Plecoptera			
Ephemeroptera			
Caenis sp.	1		
Stenacron interpunctatum	7		
Stenonema tripunctatum	1		
Odonata			
Hemiptera			

	No.	A.	I.
Coleoptera			
Neuroptera and Megaloptera			
Crustacea			
Isopoda	2		
Oligochaeta Tubificidae	2 ~~4~~		
Hirudinea			
Bivalvia			
Sphaeridae (Eupara)	~~2~~		
Sphaerium	3		
Gastropoda			
Bryozoa			
Coelenterata			
Other Turbellaria	6 ~~5~~		

A = Adult. I = Immature

Total No. Organisms: 100

Total No. ~~Taxa~~ Genera: 16

CPOM = 37% shredders

MACROINVERTEBRATE DATA SHEET

Type of Sampler Kicknet
Collection Depth
Substrate Type riffle
Remarks G. Bright
sorted by ~~MrBradd~~
G. Bright
Identification by ~~MrBroaddus~~

Sample No. #2
Date 12/28/94
Location
Rush Creek (Posey Co.)

Station # site 1
Collector G. Bright

Enter Family and/or Genus and Species Name on Blank Line.

Organisms	No.	A.	I.
Diptera			
Chironomidae			
Orthocladius obumbratus	18		
Cardiocladius sp.	1		
Heterotrissocladius sp.	1		
Thienemannymia group	7		
Other Tipula sp.	1		
Simuliidae	2		
Trichoptera			
Chimarra obscura	1		
Cheumatopsyche spp.	49		
Neureclipsis sp.	1		
Plecoptera			
Ephemeroptera			
Caenis sp.	1		
Stenonema tripunctatum	1		
Stenacron interpunctatum	6		
Odonata			
Hemiptera			

	No.	A.	I.
Coleoptera			
Neuroptera and Megaloptera			
Crustacea			
Caecidotea sp.	6		
Hyalella azteca	1		
Oligochaeta			
Hirudinea			
Bivalvia			
Eupera cubensis	1		
Gastropoda			
Bryozoa			
Coelenterata			
Other Turbellaria	3		

A = Adult. I = Immature

Total No. Organisms 100

Total No. ~~Taxa~~ Genera 16

CPOM = 69% shredders

Site 1

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

Rush Creek

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land Use:

Forest   Field/Pasture   Agricultural   Residential   Commercial   Industrial   Other ______

Local Watershed Erosion: None   Moderate   Heavy

Local Watershed NPS Pollution: No evidence   Some Potential Sources   Obvious Sources

Estimated Stream Width 3 m   Estimated Stream Depth: Riffle 0.1 m   Run ____ m   Pool 1 m

High Water Mark ____ m   Velocity ____   Dam Present: Yes ___ No ✓   Channelized: Yes ___ No ✓ (some upstream)

Canopy Cover: Open   Partly Open   Partly Shaded → Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal   Sewage   Petroleum   Chemical   Anaerobic   None   Other ______

Sediment Oils: Absent   Slight   Moderate   Profuse

Sediment Deposits: Sludge   Sawdust   Paper Fiber   Sand   Relict Shells   Other ______

Are the undersides of stones which are not deeply embedded black?   Yes   No

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256-mm (10 in.)	
Cobble	64-256-mm (2.5-10 in.)	20
Gravel	2-64-mm (0.1-2.5 in.)	50
Sand	0.06-2.00-mm (gritty)	20
Silt	.004-.06-mm	
Clay	<.004-mm (slick)	10

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	
Muck-Mud	Black, Very Fine Organic (FPOM)	
Marl	Gray, Shell Fragments	

WATER QUALITY

Temperature ____ C   Dissolved Oxygen ____   pH ____   Conductivity ____   Other ______

Instrument(s) Used ______

Stream Type: Coldwater   Warmwater

Water Odors: Normal   Sewage   Petroleum   Chemical   None   Other ______

Water Surface Oils: Slick   Sheen   Globs   Flecks   None

Turbidity: Clear   Slightly Turbid   Turbid   Opaque   Water Color ______

WEATHER CONDITIONS

PHOTOGRAPH NUMBER

OBSERVATIONS AND/OR SKETCH

Site 1

Rush Creek 7/6/94

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category: Excellent	Good	Fair	Poor
1. *Bottom substrate/available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow, at rep. low flow[a]	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 16-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

69

Figure 5.2-1. Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

Site 1

Rush Creek

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category: Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio[a] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability[a]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability[b]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 6-8	25-49% of the stream-bank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover[b]	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 3-5	Over 50% of the stream-bank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	___	___	___	___

Score 107

38
+69
107

Figure 5.2-1. (Cont.).

Site 2 and 3

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

Barr Creek - ~~DS~~

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land Use:

Forest   Field/Pasture   Agricultural   Residential   Commercial   Industrial   Other ________

Local Watershed Erosion: None   Moderate   Heavy

Local Watershed NPS Pollution: No evidence   Some Potential Sources   Obvious Sources

Estimated Stream Width 2 m   Estimated Stream Depth: Riffle 0.05 m   Run ____ m   Pool 0.5 m

High Water Mark ____ m   Velocity ____   Dam Present: Yes __ No ✓   Channelized: Yes ✓ No __   few spots w/ current approaching 30cm/sec

Canopy Cover: Open   Partly Open   Partly Shaded   Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal   Sewage   Petroleum   Chemical   Anaerobic   None   Other ________

Sediment Oils: Absent   Slight   Moderate   Profuse

Sediment Deposits: Sludge   Sawdust   Paper Fiber   Sand   Relict Shells   Other ________

Are the undersides of stones which are not deeply embedded black?   Yes   No

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256-mm (10 in.)	
Cobble	64-256-mm (2.5-10 in.)	
Gravel	2-64-mm (0.1-2.5 in.)	10
Sand	0.06-2.00-mm (gritty)	60
Silt	.004-.06-mm	30
Clay	<.004-mm (slick)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	
Muck-Mud	Black, Very Fine Organic (FPOM)	
Marl	Gray, Shell Fragments	

WATER QUALITY

Temperature ____ C   Dissolved Oxygen ____   pH ____   Conductivity ____   Other ________

Instrument(s) Used ________

Stream Type: Coldwater   Warmwater

Water Odors: Normal   Sewage   Petroleum   Chemical   None   Other ________

Water Surface Oils: Slick   Sheen   Globs   Flecks   None

Turbidity: Clear   Slightly Turbid   Turbid   Opaque   Water Color ________

WEATHER CONDITIONS   hot

PHOTOGRAPH NUMBER   picture

OBSERVATIONS AND/OR SKETCH   pool bottoms not filled w/ muck

at mouth, stream bottom is hardpan or bedrock in some places

Sites 2 and 3

Barr Creek

7/5/94

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category: Excellent	Good	Fair	Poor
1. *Bottom substrate/ available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) = *Flow at rep. low flow[a]	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 16-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) = Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

35

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

Figure 5.2-1. Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

Sites 2 and 3
Barr Creek

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

DKS 7/5/94

Habitat Parameter	Category: Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio[a] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability[a]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability[b]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover[b]	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	___	___	___	___

Score 61

$$\begin{array}{r} 26 \\ +\,35 \\ \hline 61 \end{array}$$

Figure 5.2-1. (Cont.).

Sites 4 and 5

Big Creek - ~~OK~~

7/5/94

PHYSICAL CHARACTERIZATION/WATER QUALITY
FIELD DATA SHEET

PHYSICAL CHARACTERIZATION

RIPARIAN ZONE/INSTREAM FEATURES

Predominant Surrounding Land Use:

Forest Field/Pasture Agricultural Residential Commercial Industrial Other ______

Local Watershed Erosion: None Moderate Heavy

Local Watershed NPS Pollution: No evidence Some Potential Sources Obvious Sources

Estimated Stream Width 6 m Estimated Stream Depth: Riffle 0.1 m Run ____ m Pool 0.6 m

High Water Mark ____ m Velocity ≥30 Dam Present: Yes ____ No √ Channelized: Yes √ No ____

Canopy Cover: Open Partly Open Partly Shaded Shaded

SEDIMENT/SUBSTRATE:

Sediment Odors: Normal Sewage Petroleum Chemical Anaerobic None Other ______

Sediment Oils: Absent Slight Moderate Profuse

Sediment Deposits: Sludge Sawdust Paper Fiber Sand Relict Shells Other ______

Are the undersides of stones which are not deeply embedded black? Yes No

Inorganic Substrate Components

Substrate Type	Diameter	Percent Composition in Sampling Area
Bedrock		
Boulder	>256-mm (10 in.)	
Cobble	64-256-mm (2.5-10 in.)	
Gravel	2-64-mm (0.1-2.5 in.)	10
Sand	0.06-2.00-mm (gritty)	50
Silt	.004-.06-mm	80
Clay	<.004-mm (slick)	

Organic Substrate Components

Substrate Type	Characteristic	Percent Composition in Sampling Area
Detritus	Sticks, Wood, Coarse Plant Materials (CPOM)	little snag habitat available
Muck-Mud	Black, Very Fine Organic (FPOM)	
Marl	Grey, Shell Fragments	

WATER QUALITY

Temperature ____ C Dissolved Oxygen ____ pH ____ Conductivity ____ Other ______

Instrument(s) Used ______

Stream Type: Coldwater Warmwater

Water Odors: Normal Sewage Petroleum Chemical None Other ______

Water Surface Oils: Slick Sheen Globs Flecks None

Turbidity: Clear Slightly Turbid Turbid Opaque Water Color green w/ algae

WEATHER CONDITIONS hot

PHOTOGRAPH NUMBER mussels present

OBSERVATIONS AND/OR SKETCH pool bottoms fairly solid, not mucky

Sites 4 and 5

Big Creek - ~~DKS~~

7/5/94

HABITAT ASSESSMENT FIELD DATA SHEET

Habitat Parameter	Category: Excellent	Good	Fair	Poor
1. *Bottom substrate/ available cover[a]	Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. 16-20	30-50% rubble, gravel or other stable habitat. Adequate habitat. 11-15	10-30% rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10	Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. 0-5
2. Embeddedness[b]	Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment 16-20	Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment 11-15	Gravel, cobble, and boulder particles are between 50 and 75 % surrounded by fine sediment 6-10	Gravel, cobble, and boulder particles are over 75 % surrounded by fine sediment 0-5
3. ≤0.15 cms (5cfs) → *Flow at rep. low flow[a]	Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 16-20	0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15	0.01-0.03 cms (.5-1 cfs) 0.03-0.05 cms (1-2 cfs) 6-10	<0.01 cms (.5 cfs) <0.03 cms (1 cfs) 0-5
or >0.15 cms (5cfs) → Velocity/depth	Slow (<0.3 m/s), deep (>0.5 m); slow, shallow (<0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. 16-20	Only 3 of the 4 habitat categories present (missing riffles or runs receive lower score than missing pools). 11-15	Only 2 of the 4 habitat categories present (missing riffles/runs receive lower score). 6-10	Dominated by one velocity/depth category (usually pool). 0-5
4. * Channel alteration[a]	Little or no enlargement of islands or point bars, and/or no channelization. 12-15	Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. 8-11	Moderate deposition of new gravel, coarse sand on old and new bars; pools partially filled w/silt; and/or embankments on both banks. 4-7	Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or extensive channelization. 0-3
5. Bottom scouring and deposition[a]	Less than 5% of the bottom affected by scouring and deposition. 12-15	5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools. 8-11	30-50% affected. Deposits and scour at obstructions, constrictions and bends. Some filling of pools. 4-7	More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks in riffle exposed. 0-3

37

(a) From Ball 1982.
(b) From Platts et al. 1983.
Note: * = Habitat parameters not currently incorporated into BIOS

Figure 5.2-1. Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

Sites 4 and 5
Big Creek - ~~DS~~
7/5/94

HABITAT ASSESSMENT FIELD DATA SHEET (cont.)

Habitat Parameter	Category: Excellent	Good	Fair	Poor
6. Pool/riffle, run/bend ratio[a] (distance between riffles divided by stream width)	5-7. Variety of habitat. Deep riffles and pools. 12-15	7-15. Adequate depth in pools and riffles. Bends provide habitat. 8-11	15-25. Occassional riffle or bend. Bottom contours provide some habitat. 4-7	>25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. 0-3
7. Bank stability[a]	Stable. No evidence of erosion or bank failure. Side slopes generally <30%. Little potential for future problem. 9-10	Moderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. 6-8	Moderately unstable. Moderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extreme high flow. 3-5	Unstable. Many eroded areas. Side slopes >60% common. "Raw" areas frequent along straight sections and bends. 0-2
8. Bank vegetative stability[b]	Over 80% of the streambank surfaces covered by vegetation or boulders and cobble. 9-10	50-79% of the streambank surfaces covered by vegetation, gravel or larger material. 6-8	25-49% of the streambank surfaces covered by vegetation, gravel, or larger material. 3-5	Less than 25% of the streambank surfaces covered by vegetation, gravel, or larger material. 0-2
9. Streamside cover[b]	Dominant vegetation is shrub. 9-10	Dominant vegetation is of tree form. 6-8	Dominant vegetation is grass or forbes. 3-5	Over 50% of the streambank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. 0-2
Column Totals	___	___	___	22 ___

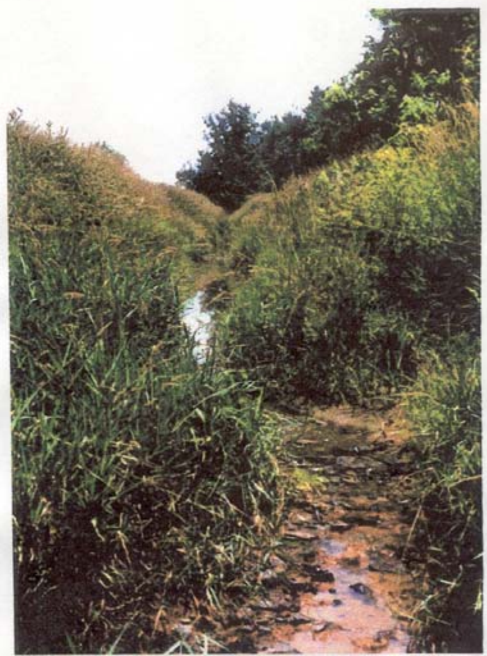
Score 59

Figure 5.2-1. (Cont.).

Rush Creek
Reference
Site 1

Barr Creek
County Line Road
Site 2

Barr Creek
Near Mouth
Site 3



Big Creek

Site 4
(upstream)

Site 5
(downstream)

Slumping Banks
Site 5